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RESEARCH ARTICLE

Preliminary investigation of two functional assessment methods for people with dementia: Effectiveness and acceptability

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Abstract

Many functional assessment procedures have been developed and validated for use with people with intellectual and developmental disabilities. However, there is a paucity of research exploring the utility and social acceptability of functional assessment methods for people with dementia. We conducted direct observations in the natural environment to produce data for conditional probability analyses and an experimental functional analysis of the behavior of two women with dementia. We found that the conditional probability analysis yielded similar conclusions about function as the data from the experimental functional analysis for both participants. Importantly, staff rated the direct observations as more socially acceptable. We also report barriers to conducting both methods in older adult settings that warrant further exploration, including the use of the assessments with people with dementia and intact vocal verbal repertoires.

KEYWORDS
conditional probability, dementia, descriptive assessment, functional analysis, major neurocognitive disorder

This manuscript has not been previously published and has not been and will not be submitted elsewhere during the review process.

1 | INTRODUCTION

There are a number of assessment procedures for problematic behaviors that are available for behavior analysts (e.g., experimental functional analyses and conditional probability analyses). However, many of these assessments were developed for and validated with people with intellectual and developmental disabilities. Beavers, Iwata, and Lerman (2013) found that 84% of published studies using functional analyses were conducted with children, and 82% were conducted with people with developmental disabilities.

Experimental functional analyses (Iwata et al., 1994) allow behavior analysts to find functional relations between target behaviors and environmental variables. They allow for the development of a function-based intervention that is more likely to be effective than an intervention that is developed without knowledge of the maintaining variables. Experimental functional analyses have been used with people with dementia to determine the function of a number of topographies of behavior including disruptive vocalizations (Buchanan & Fisher, 2002), aggression (Baker & Hanley, 2006), disruptive behaviors and wandering (Dwyer-Moore & Dixon, 2007), and "sundowning" (Stadlober, Sharp, & Mudford, 2016).

By contrast, descriptive assessments (e.g., conditional probability analyses) involve direct observation of the problem behavior as it occurs without manipulation of the environment. Descriptive assessments are often simpler and less time consuming to conduct and can be used when it is not possible to manipulate the variables related to the problem behavior (Lerman & Iwata, 1993). A conditional probability analysis is used to find the likelihood that an environmental event will occur preceding or following a specified behavior using quantifiable data (Thompson & Iwata, 2001). The conditional probability value (the likelihood of the behavior occurring in relation to a specific variable) is compared to the unconditional probability value (the overall likelihood of the behavior). The closer the correlation is to 1.0, the more confident we can be in the prediction that there is a functional relation between the behavior and variable. Because the data used in conditional probability analyses are collected in the natural environment, we may be more likely to identify idiosyncratic variables that maintain behavior or identify schedules that may be difficult to arrange in an experimental functional analysis (as discussed by Anderson & Long, 2002). Conditional probability analyses are also less intrusive to conduct than experimental functional analyses. Conditional probability analyses have been used with adults with Down syndrome and dementia to identify potential reinforcing contingencies for inappropriate verbal behavior (Millichap et al., 2003), and more recently with adults with dementia to determine the function of disruptive vocalizations (Leon, Gregory, Flynn-Privett, & Ribeiro, 2018).

Despite the above examples, there remains a paucity of research evaluating the use of functional assessments with people with dementia, particularly with regard to constraints and social acceptability. There are a number of factors that are considered when selecting or avoiding a functional assessment method. For example, Hanley (2012) identified time-consuming, complexity, riskiness, and lack of social acceptability as barriers to implementing an experimental functional analysis. Similarly, conditional probabilities are difficult to calculate. Despite a number of solutions to some of the identified barriers (e.g., conducting functional analyses on precursor-to-dangerous behaviors to minimize risk; Fahmie & Iwata, 2011), little is known about barriers to conducting functional analyses in older adult settings. For example, care homes are unlikely to have a spare room available in which to conduct an assessment, which means that interactions with other residents and staff cannot be controlled. Additionally, people with dementia may have intact vocal verbal repertoires and complex learning histories different to people with developmental disabilities (and children), and we do not yet know the resulting influence on assessment methods.

We selected two functional assessment methods (conditional probability analysis and experimental functional analysis) to conduct with older adults with dementia and intact vocal verbal repertoires. The purposes of our study were to compare the results from each assessment to determine whether the function of behavior was able to be identified, to identify possible barriers to implementation, and to evaluate staff acceptability of each method.

TABLE 1 Operational definitions of each of the environmental variables recorded

Variable	Operational definition
Attention	Verbal comments (praise, reprimand, encouragement, statement, conversation, or conversational questions e.g., "It's lovely outside today, isn't it") directed to the participant, gestures directed to the participant (pointing, sign language, and head shake), or physical contact initiated by another person (e.g., prompts, pats, cuddles, and handing something over).
Demand	Verbal instructions or requests directed to the participant specifying that they were to commence, continue, or cease a physical behavior (e.g., move and give something).
Other person present	Another person is present within the walls of the same room as the participant (including observer).

2 | METHODS

2.1 | Participants and setting

Martha and June resided in a privately owned 21-bed home that specialized in supporting adults with dementia. Martha was 91 years old and was diagnosed with mixed type dementia. She was ambulatory and spent a large proportion of the day walking around the care home. Martha had an extensive vocal verbal behavior repertoire but would often not be able to accurately report previous conversations; she often asked questions that had just been answered or repeated comments that she had made within the last few minutes. June was 82 years old and diagnosed with Alzheimer's disease. She was ambulatory but spent a large proportion of her day sleeping in the lounge. June had an intact vocal verbal behavior repertoire, but her verbal behavior often appeared to be under faulty stimulus control (i.e., responses were topographically coherent and grammatically correct but often not related to the preceding verbal S^Ds). We conducted sessions wherever participants were located at the time, often the lounge or hallway. Participants were free to move between locations at all times during the sessions.

2.2 | Measurement and interobserver agreement

We recorded the frequency of one problem behavior for each participant, and the duration of three environmental variables. Operational definitions for the three environmental variables we recorded are displayed in Table 1. The behavior of interest for Martha was any question or statement that referenced home as somewhere other than the care home in which she resided, including requests for staff to get her coat and bag, or asking when a family member could come to pick her up. Examples included "Even if I do get home, I don't have my key" and "Are you going my way? If you are, can you take me?". We recorded each complete statement or question as one occurrence of the behavior. The behavior of interest for June was speaking to residents and staff in a rude manner; this included statements, questions, and demands for them to move or to give information in a short, sharp tone, often accompanied by a profanity or insult. Usually this information was not something the listener could provide, for example, she approached other residents and asked "Is that happening tomorrow?" When June was told that the listener could not provide the requested information or was asked for clarification, she would often respond with a comment such as "ah, you're a useless bitch."

We collected continuous data using ObsWin32 (Martin, Oliver, & Hall, 2001) on laptop computers. A second recorder collected data in 64% of sessions. The data files were divided into 10-s intervals from the beginning of the

data file (i.e., the first 10 s of the file comprised the first 10-s interval), continuing to the end of the data file. Interobserver agreement (IOA) was calculated by dividing the number of intervals in which both observers agreed on the presence or absence of each variable by the total number of 10-s intervals. IOA was in 99% for the presence of an activity (range, 90%–100%), 95% for attention (range, 70%–100%), 100% for the presence of another person, 98% for the target behavior of vocalizations about home for Martha (range, 93%–100%), and 92% for the target behavior of rude behavior for June (range, 76%–100%). During the pairwise experimental functional analysis, IOA was 99% for task-related rude behavior (range, 94%–100%) and 97% for all other rude behavior (range 95%–-100%). Procedural integrity data were recorded in 33% of the experimental functional analysis sessions by completion of a task analysis checklist by a second trained observer. On average, 99% of the steps were completed accurately during the observed sessions (range, 99%–100%).

2.3 | Procedure

2.3.1 | Direct observation for conditional probabilities

We observed each participant for eight 10-min sessions and recorded all variables of interest. Staff were instructed to continue with their tasks and to respond as they usually would when the target behavior occurred. Sessions were conducted at varied times between 9 a.m. and 5 p.m. across 14 days, and were conducted when it was reported that the behavior was more likely to occur (e.g., for Martha this was between mealtimes). No more than two sessions were conducted in a day.

2.3.2 | Experimental functional analyses

For Martha, functional analysis sessions were 40 min in duration (10-min conditions). Because June walked from room to room frequently (approximately every 5 min) when she was awake, sessions were 20 min for her (5-min conditions). The sessions were based on Iwata et al. (1994) and comprised of each of the following conditions in the following order: ignore, attention, control, and escape. We conducted the conditions in this order to capitalize on contrived motivating operations (Hammond, Iwata, Rooker, Fritz, & Bloom, 2013). Staff delivered consequences in the functional analyses that mirrored typical staff responses to the behavior (e.g., attention for Martha's behavior was informing her that she lived in the care home, and attention for June's behavior was attempting to answer her question with comments such as “oh, I'm not sure”). During the control condition, a cup of tea and activity were within reach of the participant, and attention was provided at least every 30-s. During the attention condition, attention was delivered contingent on the occurrence of the target behavior. During the escape condition, Martha was asked to fold a stack of cleaned towels and June was asked to turn the page of a magazine. During the ignore condition no attention, demands, or activities were provided to the participant, and the researchers and staff were present.

2.3.3 | Pairwise functional analysis

For June, three additional pairwise experimental functional analysis sessions were conducted, with alternating 5-min control and escape conditions. During these pairwise sessions, rude behavior that specifically related to the demand (e.g., “oh do it yourself, lazy bitch!”) was recorded separately to any other rude behavior that did not specifically relate to the demand (e.g., “ah, you're a bitch!”). Demands were removed contingent on both demand-specific rude behavior and any other rude behavior during pairwise sessions.

We instructed staff to deliver the contingencies in the functional analyses at the beginning of each session using verbal rules (e.g., "when June asks you a question, please respond that you don't know"). During each condition, the staff member wore a different colored apron to assist in discrimination between conditions (e.g., Conners et al., 2000). The staff had no knowledge, training, or experience of any behavior-analytic concepts or interventions before the start of the study.

2.3.4 | Staff interviews

We conducted staff interviews after all observation and functional analysis sessions in which we asked open-ended questions about the acceptability of the two methods. We based our questions on the Treatment Evaluation Inventory Short Form (Kelley, Heffer, Gresham, & Elliott, 1989).

3 | RESULTS

We analyzed the data from the direct observation sessions by calculating the conditional and unconditional probability of attention being delivered following the target behavior across all observations for each participant. We calculated the probabilities for each second following the occurrence of the target behavior for 10 s. The probability of the behavior occurring when a demand was placed, and when the participant was left alone was not able to be calculated due to the extremely low number of occurrences of these events. Additionally, we graphed the data from the direct observation sessions on occurrence graphs to analyze the presence of any temporal relationships between the target behavior and another variable that may not have been identified using the experimental functional analysis or the conditional probability analysis. We have included one graph per participant as an example of this analysis.

3.1 | Direct observations

The top left panel in Figure 1 shows the data from one of the eight observation sessions with Martha and the top left panel in Figure 2 shows the data from one observation with June. During this observation with Martha, the target behavior occurred 37 times, and five of those occurrences were followed within 5 s by the delivery of attention. Across all eight observations, attention was delivered on average following 5.4 consecutive occurrences of the target behavior (range, 1.2–26) which may suggest that if the behavior was maintained by attention, it was reinforced on a variable schedule. There was no consistent temporal relation between any of the recorded variables and the behavior in the data across the eight observations, and so the data do not lead us to suggest a singular function for June's behavior.

3.2 | Conditional probability analyses

For both participants, there were almost no occurrences of being alone in the room (<3% of observed time for Martha and <1% of observed time for June), and there were only a very small number of demands placed (six in total during all observations with June and twice during all observations with Martha). We were therefore not able to calculate the conditional probability of the target behavior in relation to demands placed or in relation to the participant being alone.

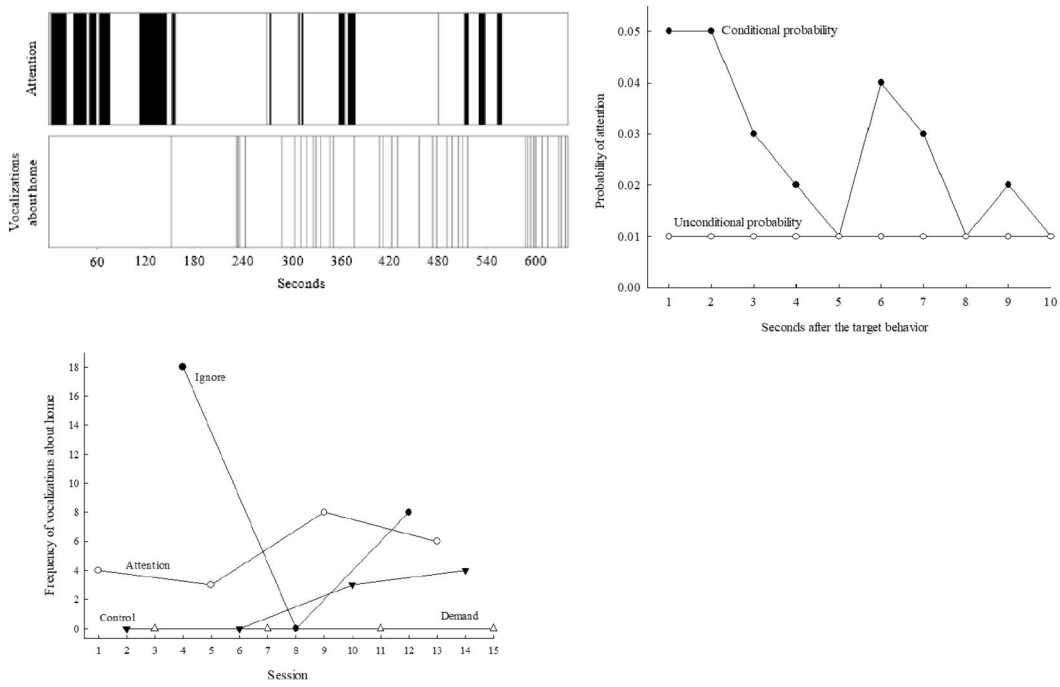

FIGURE 1 The top left panel shows the occurrence of the target behavior by Martha, and occurrence and duration of attention delivered during a 10-min observation session. The width of each bar indicates the duration of attention delivered. The top right panel shows the conditional probability of attention being delivered following the occurrence of the target behavior by Martha in comparison to the unconditional probability of attention being delivered. Each lag interval is 1 s post occurrence of the target behavior. The bottom panel shows the frequency of vocalizations about home made by Martha during each 10 min condition in the experimental functional analysis

The top right panel in Figure 1 shows the conditional probability of attention occurring at each consecutive second after the occurrence of the target behavior in comparison to the unconditional probability of attention occurring (i.e., not in relation to another variable) for Martha's behavior. The probability of attention increased in seconds 1–4, 6, 7, and 9 following the occurrence of the target behavior. The top right panel in Figure 2 shows the conditional probability of attention occurring at each consecutive second past the occurrence of the target behavior in comparison to the unconditional probability of attention occurring for June's behavior. Attention was more likely to occur for the first 4 s following the behavior for June, less likely to occur for the following 2 s and then more likely to occur for three out of the following 4 s.

3.3 | Experimental functional analyses

The bottom left panel in Figure 1 shows the frequency of Martha's target behavior during each of the conditions in the experimental functional analysis. The first data point for the ignore condition was not included on the graph because experimental control was compromised due to other residents providing attention contingent on the occurrence of the target behavior. Martha independently retrieved and folded each tea towel until the end of the session without additional instruction during the demand condition. As all age-appropriate tasks that we tried appeared to become preferred activities (inferred from Martha's verbal behavior during the task), and there were

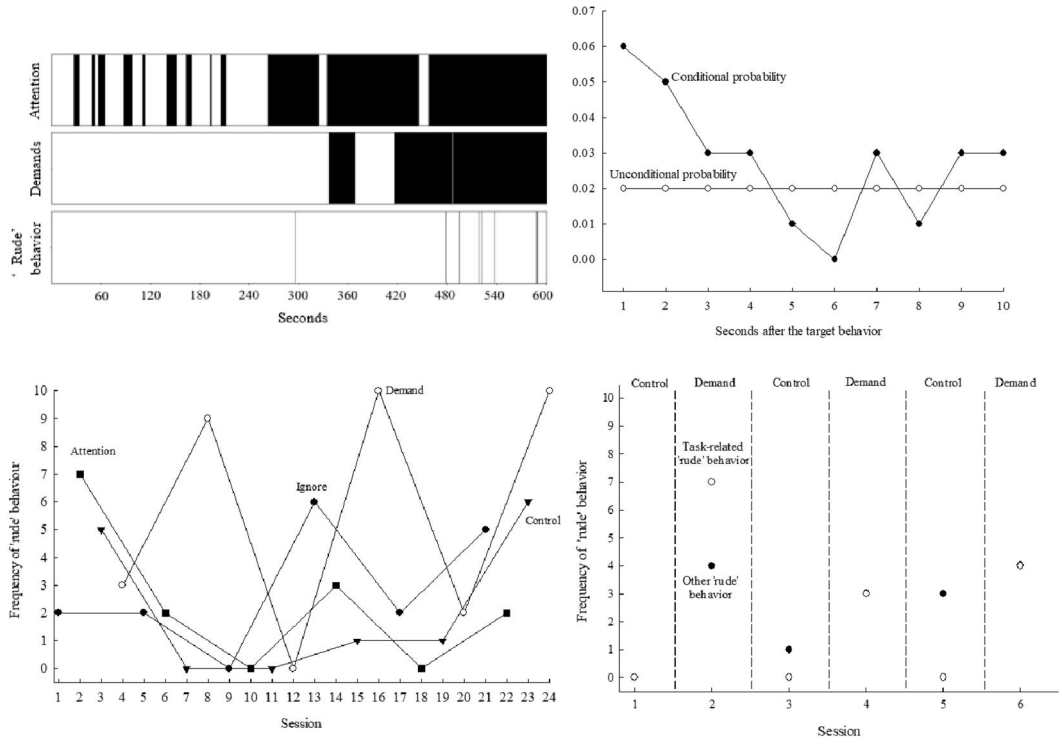

FIGURE 2 The top left panel shows the occurrence of the target behavior, attention, and demands placed during a 10 min observation of June's behavior. The width of each bar indicates the duration of attention or the demand delivered. The top right panel shows the conditional probability of attention being delivered following the occurrence of "rude" behavior by June in comparison to the unconditional probability of attention being delivered. Each lag interval is 1 s post occurrence of the target behavior. The bottom left panel shows the frequency of June engaging in "rude" behavior during each 5 min session during the experimental functional analysis. The bottom right panel shows the frequency of task related "rude" behavior and all other "rude" behavior displayed by June during each condition of the pairwise functional analysis

no occurrences of the behavior during the demand sessions, we can assume that her behavior was not maintained by escape. Overall, the ignore condition produced the highest rates of the target behavior for Martha, but the attention condition produced the most consistent rates of behavior.

The results from the experimental functional analysis with June are shown in the bottom left panel in Figure 2 and show relatively similar rates of responding in the control, ignore, and attention conditions, and higher rates of behavior in the demand condition. During the demand condition, it was noted that there may be a separate topography of the "rude" behavior that was not observed during the other conditions. Specifically, June would engage in verbal behavior that specifically related to escape from the demand. It was hypothesized that although this was captured by our original operational definition of "rude" behavior and was being recorded as such, that the demands may have evoked a similar response class with a separate function to the behavior we intended to analyze. To measure this, we alternated the control and demand conditions in a pairwise experimental functional analysis. During the pairwise analysis, we measured task-related rude behavior as a separate topography to other rude behavior (bottom right panel in Figure 2). When the task-related rude behavior was recorded as separate, the rates of the other rude behavior (range, 0–4) approximated the frequency of the "rude" behavior in the other conditions in the standard experimental functional analysis (range, 0–7).

4 | DISCUSSION

We conducted an experimental functional analysis and natural environment observations of the behavior of two women with dementia who had intact vocal verbal repertoires. For Martha, we found that the results from the experimental functional analysis indicated a social attention function of the behavior and the results from the conditional probability analysis indicated that there might have been a social attention function to the behavior. For June, neither analysis yielded a clear function for the behavior. We suspect that June's behavior may have served multiple functions and we were therefore measuring multiple response classes within our definition. Alternatively, the behavior was automatically maintained. The conditional probability analyses that we were able to conduct and the experimental functional analyses produced similar conclusions regarding the function of each participant's behavior.

4.1 | Experimental functional analysis limitations

4.1.1 | Stimulus control

In the experimental functional analysis with Martha, there were higher rates of behavior in some of the ignore condition sessions and more consistently high rates in the attention condition. Because the S^Ds were similar between these two conditions (i.e., the staff member was doing "work" and not initiating interactions), it may be that Martha failed to discriminate between the conditions. As there is emerging evidence that one of the characteristics of dementia is deterioration in the ability to discriminate stimuli (e.g., Gallagher & Keenan, 2009; Steingrimsdottir & Arntzen, 2011), this may not be entirely unexpected. We noted that Martha directed verbal behavior such as "oh, sod you then if you're going to be like that" toward the staff member, and would then stop requesting attention or engaging in the target behavior. Her lack of responding during the last ignore session may indicate that she had learned to discriminate between the conditions and did not engage in the behavior during the session as a form of counter control, or simply the apron associated with that condition had become an S^{Δ}.

4.1.2 | Staff implementation

We instructed staff to deliver the contingencies in the experimental functional analysis to more closely mirror the contingencies that occurred in the natural environment, but a limitation of our study is that we did not conduct formal Behavioral Skills Training (Parsons, Rollyson, & Reid, 2012). Previous research has found that staff can be trained to implement experimental functional analyses with relative ease (e.g., Phillips & Mudford, 2008). We found procedural integrity to be high, however, we encountered a number of practical barriers to staff conducting the experimental functional analyses in this setting. Staff availability was a frequent issue because staff were busy or were required to be physically present in other parts of the home to comply with legal requirements. Dementia services are often understaffed and have a high staff turnover (Castle & Engberg, 2005), so it is not unusual for staff to lack spare time to conduct an assessment as lengthy as an experimental functional analysis. However, briefer sessions might be more feasible.

4.1.3 | Extraneous sources of reinforcement

To mirror natural contingencies, we conducted the functional analyses in the location where the participant was found at the beginning of the session. However, this meant that it was more difficult to control the extraneous

sources of reinforcement provided by staff members or residents that were not involved in the study (e.g., resident shouting "shut up!" when Martha's behavior increased in frequency or telling June she was being rude). For stronger experimental control, experimental functional analyses should be conducted in a separate room without other residents and staff. However, in many care homes, including the one in our study, a safe, vacant, and suitable room is not available.

The artificial arrangement of the experimental functional analysis, despite our efforts to mirror natural contingencies, evoked some behavior from the participants that was not observed outside of the experimental functional analysis. For example, during one ignore condition, Martha said "Well, if you're going to be (rude) like that…" and left the room. She found a tradesman in another room and began to engage him in conversation; therefore, accessing the social reinforcement that she was not obtaining from the staff member. June displayed increased intensity of task-related "rude" behavior during the demand condition, including swatting at the experimenter and throwing the task materials away. It may be that the artificial arrangement of the experimental functional analysis is a factor for consideration when working with participants with intact vocal verbal repertoires or those with a "typical" learning history. It would be interesting to see whether similar issues arise with people with dementia and less intact verbal repertoires.

4.2 | Conditional probability limitations

4.2.1 | Limited data

We were limited in the analyses we could conduct by the data we obtained from the direct observation sessions. Demands were rarely placed during any of the observations, and other residents or staff were almost always present. Therefore, we were not able to analyze the conditional probability of escape occurring contingent upon the target behavior, or being alone preceding the target behavior (i.e., to test for automatic function). However, the behavior still occurred in the absence of demands, indicating that escape from demand was unlikely to be the only function of the behavior. Similarly, although other people were often in the room, they were not providing attention; staff were busy or other residents were unable or unwilling to interact with the residents. Older adults in long-term care often spend the majority of their day without social interaction from staff or other residents (McKee, Harrison, & Lee, 1999). Therefore, periods where there were other people present but not providing attention to the participant are similar in the arrangement of S^Ds to those present in the ignore condition of the experimental functional analysis. Longer observation sessions may have yielded data that would have allowed us to conduct analyses of the probability of escape and alone contingencies, and are advisable for future research.

One of the benefits to the direct observation sessions required to conduct the conditional probability analyses was the ease and efficiency with which we were able to conduct them. Working with a population with a high mortality rate (Mitchell, Teno, Miller, & Mor, 2005) means that waiting for suitable days where the staff, residents, and space are all available simultaneously may prevent significant change in such a limited time frame. However, we required software to conduct the analyses to which many clinicians would not have access.

Despite the benefits in terms of staff time and effort, conditional probability analyses are only correlational. Simply because a behavior and environmental event are correlated strongly or are temporally related, a functional relation cannot be confirmed. For example, it may be that staff always respond to a target behavior with attention, even when the function is escape, but escape is on a leaner variable schedule of reinforcement. Thompson and Iwata (2001) found that attention was the most common consequence delivered following problem behavior regardless of function. Conditional probability analyses may be only of use in circumstances where the behavior is on a relatively dense schedule of reinforcement.

4.3 | Staff reports on acceptability

Both staff members who delivered the contingencies in the experimental functional analysis reported that the direct observation sessions for the conditional probability analyses were more socially acceptable than the functional analysis. The staff member for June reported that although the direct observations were more socially acceptable to conduct than functional analyses, she thought the experimental functional analysis would be more effective. However, the staff member for Martha reported a strong dislike for the experimental functional analysis. We suspect that she found the experimental functional analysis aversive because of the topography of behaviors displayed by Martha during the first two ignore sessions. For example, Martha was recorded as saying "why are you ignoring me, have I done something wrong? I usually have… I'm sorry for what I've done, please speak to me". This particular topography was very difficult for staff to ignore and the behavior would have likely been reinforced lower in the response class hierarchy in the natural environment. It was not unusual for Martha to not receive attention for longer than 10 min, but this specific behavior would have likely resulted in staff attending to her behavior immediately. We suspect that this particular topography of behavior was more likely to access attention from staff than other forms of disruptive behavior (e.g., physical aggression) because attending to this topography of behavior reinforces private events staff may have about "caring" for older adults (e.g., that they should provide "comfort" when the client is distressed). The effect of particular topographies of verbal behavior on the behavior of staff may need to be a consideration for behavior analysts working with adults who have a largely intact vocal verbal repertoire. It is worth noting that we involved the staff by having them conduct the experimental functional analysis contingencies, therefore, their social acceptability reports may have been affected by their involvement in the study. However, as behavior-analytic practice often involves training staff members, we believe that staff members who implement rather than simply observe the assessments provide valuable ratings based on experience.

Overall, experimental functional analyses are an experimentally rigorous method for determining the function of problem behavior. However, special consideration needs to be given to the arrangement of contingencies in experimental functional analyses when working with populations with "typical" learning histories and an intact vocal verbal repertoire. Descriptive analyses may provide a more socially acceptable assessment than experimental functional analysis, and provide more data on the temporal relations between variables. We found that neither analyses were better than the other for identifying function, and both were limited practically. Staff reported the method of direct observation used to conduct probability analyses to be more acceptable than experimental functional analyses. Our study represents a preliminary analysis, and using a reversal design would serve to provide a stronger argument for the utility and efficacy of both methods.

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CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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